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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/844,855	04/26/2001	Song-Hua Shi	42390P10937	1410

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EXAMINER

OWENS, DOUGLAS W

ART UNIT

PAPER NUMBER

2811

DATE MAILED: 06/20/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/844,855

Applicant(s)

SHI ET AL.

Examiner

Douglas W Owens

Art Unit

2811

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 21 April 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-26 and 28 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-26,28 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ 6) ☐ Other: _____

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on April 21, 2003 has been entered.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1, 9-11, 13-17, 19-26 and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over US patent No. 6,180,696 to Wong et al. in view of US patent No. 5,026,816 to Keehan.

Regarding claim 1, Wong et al. teaches a no-flow material comprising:

an epoxy resin (first line of abstract);

at least one agent acting as a cross-linking hardener (Col. 5, lines 1 and 2) and a curing catalyst capable of catalyzing the curing of the epoxy resin (Col. 5, lines 13-22);
and

a fluxing agent (Col. 5, lines 23-47).

Wong et al. does not teach an epoxy-based resin including oxirane grafted silica particles.

Keehan discloses a SiloxiraneTM epoxy resin (Col. 3, lines 53-56; Col. 4, lines 3-6 and 36-39), which is an epoxy-based resin including oxirane grafted silica particles. It would have been obvious to one of ordinary skill in the art to incorporate the SiloxiraneTM epoxy resin taught by Keehan into the device taught by Wong et al., since SiloxiraneTM epoxy resin is a known material that is well suited for the intended use. The selection of a known material based on its suitability for its intended use supported a *prima facie* obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). It would have been further obvious to employ the SiloxiraneTM epoxy resin since it has enhanced chemical and corrosion resistance, high adhesive strength, high heat deflection temperatures and toughness (Keehan, Col. 3, lines 17-19).

Regarding claim 9, the proposed material of Wong et al. and Keehan discloses no-flow underfill, as recited above, further disclosing wherein the agent acting as a cross-linking hardener and a catalyst includes both a hardener and a catalyst (Wong et al., Col. 5, lines 1 and 2, and 13-22).

Regarding claim 10, the proposed material of Wong et al. and Keehan teach a no-flow underfill, further teaching wherein the agent acting as a cross-linking hardener is an anhydride (Wong et al., Col. 5, lines 1-5).

Regarding claim 11, the proposed material of Wong et al. and Keehan teach a no-flow material, wherein the catalyst is an imidazolium salt (Wong et al., Col. 5, line 21).

Regarding claim 13, Wong et al. teaches a no-flow underfill, wherein the fluxing agent is glycerol – $C_3H_5(OH)_3$ – which has three hydroxyl (OH) groups (Col. 5, line 44).

Regarding claims 14 and 15, Wong et al. teaches a no-flow underfill, further comprising a silane coupling agent as an adhesion promoter (Col. 6, lines 1 and 2).

Regarding claim 16, Wong et al. teaches a no-flow underfill, further comprising a non-ionic surfactant (Col. 6, lines 10-20).

Regarding claim 17, Wong et al. teaches a no-flow underfill, wherein the surfactant is a polyol (Col. 6, line 17).

Regarding claims 19 and 20, neither Wong et al. nor Keehan teach a no-flow underfill including silver flakes. Wong et al. teaches that "...the epoxy material may also include various additives known to those skilled in the art...to obtain...better thermal or electrical conductivity...". (Col. 14, lines 27-33). It is known in the art to use silver flakes to provide electrical conductivity (as admitted by Applicant in the prior art section [0021]). It is also known to use silver flakes to provide thermal conductivity. It would have been obvious to one of ordinary skill to add the silver flakes too obtain better electrical and thermal conductivity, which Wong teaches is desirable.

Regarding claim 21, neither Wong et al. nor Keehan teach a no-flow underfill wherein the thermally conductive particles are diamond. It would have been obvious to one of ordinary skill in the art to use a known material that is well suited for the intended

use as discussed above. Wong et al. further discusses that it is desirable to enhance the thermal conductivity as discussed above.

Regarding claims 22-24, the proposed material of Wong et al. and Keehan teach a no-flow underfill, as recited above, including the limitations recited in claim 22.

Regarding claims 25 and 28, Wong et al. and Keehan teach a no-flow underfill, as recited above, including the limitations cited in claim 25 noting that the teaching of Wong et al. is for use in flip-chip technology. It is understood in the art that flip chip technology refers to a device, wherein the die and substrate have contact and bond pads, respectively, wherein conductive bumps contact the pads; this being the standard means by which a "flipped" chip is electrically connected to a substrate.

4. Claims 2-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wong et al. and Keehan as applied to claim 1 above, and further in view of Japanese Patent No. 61112086 to Inokuchi et al.

Regarding claim 2, Wong et al. and Keehan teach a no-flow underfill, as recited above, further teaching wherein the epoxy-based resin is represented by



where:

R1 includes SiO₂ (see final compound of Keehan, displayed across Cols. 7 and 8);

R2 is a reactive organic functional group (see the oxirane group in the final compound); and

R3 is an organic chain segment (see the aliphatic moiety in the final compound).

Alternatively, Inokuchi et al. teaches an epoxy-based resin represented by



Where R1 – R3 – R2 have the same meaning as above (see the cyclic oxirane attached to the short chain which is attached to the Si containing group, Figure 1, page 1022, Japanese Patent).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the proposed material as disclosed by Wong et al. and Keehan by providing for a SiloxiraneTM (epoxy-based-resin) resin represented by R1 – R3 – R2 where R1 – R3 – R2 have the same meaning as above, as proposed by Inokuchi et al. to obtain the benefit of providing for the compound to be free of the strong UV chromophores that are present in an aromatic ring epoxy resin, as taught by Wong et al. (Col 4, lines 46-49).

Regarding claims 3 and 18, the proposed material of Wong et al., Keehan, and Inokuchi et al. teach a no-flow underfill, as recited above, with the exception of the explicit disclosure of R1 being a surface-grafted fused silica particle with a size less than 50 microns. It would have been obvious to one of ordinary skill in the art to select fused silica since it is a known material that is well suited for the intended use, as discussed above. With regard to the size of the silica particle, it has been held that arriving at result effective variables only requires ordinary skill in the art.

Regarding claim 4, the proposed material of Wong et al., Keehan , and Inokuchi et al. discloses a no-flow underfill, as recited above, further disclosing wherein R1 is a cyclic SiO₂ (Keehan, final product illustrated across Cols. 7 and 8).

Regarding claim 5, Wong et al., Keehan , and Inokuchi et al. teaches a no-flow underfill, as recited above, further disclosing wherein R1 includes an oxygen atom linked to the silica particle, R3 being linked to the oxygen atom (Keehan, final product illustrated across Cols. 7 and 8, where a silicon ion from the silica particle is linked to an oxygen atom which is linked to an R3 group (i.e., an organic chain segment)).

Regarding claim 6, Wong et al., Keehan , and Inokuchi et al. teaches a no-flow underfill, wherein R2 includes the oxirane group (Keenhan, final product, Cols. 7 and 8 or alternatively Inokuchi et al., Figs. 1 or 2, page 1022).

Regarding claim 7, Wong et al., Keehan , and Inokuchi et al. teach a no-flow underfill, as recited above, wherein R2 is an oxirane group wherein R3 and R' are attached to one of its two carbons and R'' and R''' are attached to the other carbon and where R', R'' and R''' are hydrogen or alkyl groups (Inokuchi et al., Fig. 2, page 1022).

Regarding claim 8, Wong et al., Keehan , and Inokuchi et al. teach a no-flow underfill, as recited above, wherein R1 is attached to R3 which is attached to R2 and wherein R2 is one of the oxirane groups illustrated in claim 8 groups (Inokuchi et al., Fig. 2).

Response to Arguments

5. Applicant's arguments filed April 21, 2003 have been fully considered but they are not persuasive.

The applicant argues that Keehan does not teach an epoxy-based resin including oxirane grafted silica. See Col. 2, line 67 – Col. 3, line 5, where Keehan discusses an oxirane grafted silica. Keehan further discusses a material referred to as SiloxiraneTM (Col. 4, lines 36 – 41, for example). SiloxiraneTM is known to be an epoxy-based resin including oxirane grafted silica particles.


Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Douglas W Owens whose telephone number is 703-308-6167. The examiner can normally be reached on Monday-Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on 703-308-2772. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

DWO
June 14, 2003


TOM THOMAS
SUPERVISORY PATENT EXAMINER
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